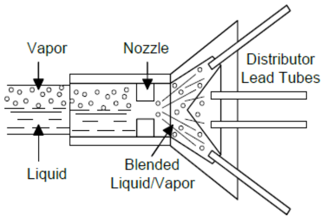
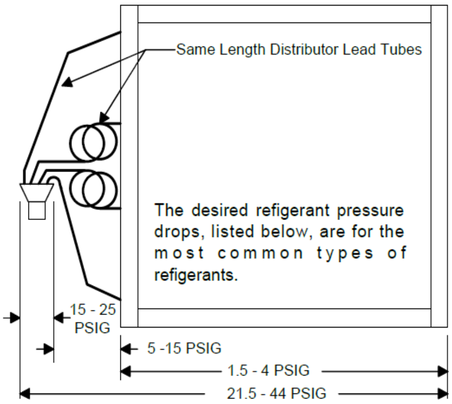
Direct Expansion or DX Coils

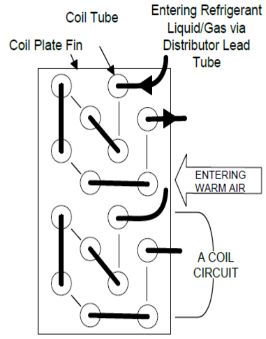
An evaporator or direct expansion (DX) coil exploits the “refrigeration effect”. Cooling results from a pressure drop applied to a fluid under pressure and at a temperature above its normal boiling point. This makes the fluid want to boil ,(also termed “flash”) to a gas. For the fluid to boil, the liquid must absorb heat from the surrounding environment, thus cooling that environ. Refrigerants are a mixture of chemicals that boil at sub ambient temperatures, some down to –36° C. If the pressure of the refrigerant is controlled, the flash point temperature of the liquid refrigerant is determined. Typically refrigeration systems use an expansion control valve located at the evaporator coil, this senses the temperature of the gaseous refrigerant leaving the coil, thereby regulating the amount of liquid entering the coil.



As liquid refrigerant passes through the expansion control valve, part of the liquid flashes to a gas. upon exiting, the stream is mostly liquid, but the vapour occupies more space. This causes the two fluids to travel at different rates and separate, with the gas at the top and the liquid at the bottom of the stream. If the refrigerant stream is not properly mixed and distributed, then some coil circuits receive mostly vapour, and other circuits the liquid, this separation degrades the heat transfer capabilities of the evaporator coil.



To avoid separation, evaporator coils come with distributors, these are ideally positioned pointing up or down to minimize this liquid/gas separation, they blend the two fluids, and evenly divides the stream between the individual coil circuits. To maintain the correct proportion of liquid/gas in the stream travelling from the manifold to coil tubes, distributor lead tubes are used. These lead tubes are the same length, ensuring a nearly identical pressure drop between the distributor and each coil circuit, as a racing exhaust manifold has equal pipe lengths between the cylinder head ports and the jointing point.



Also inside the distributor is an orifice, as the refrigerant flows through the nozzle, its speed increases, helping to blend the fluids and create the correct pressure drop, so the “flashing” process can start to occur inside the coil tubes. It is important that the manifold's; overall magnitude, nozzle orifice diameter and lead tube length be properly sized. They all affect the amount of pressure drop in the refrigerant stream and the resulting “flash” temperature in the coil. If not properly sized for the type of refrigerant and system operating conditions, then the temperature of the leaving hot gas will be different. The incorrect sizing of the manifold components will cause an incorrect expansion control valve response, this can starve or flood the compressor with refrigerant; causing the system to shut down, to avoid damage from a low or high head pressure.

Some evaporator coils do not have a distributor, on this type of coil; correct sizing of the headers, lead tubes, coil circuiting, size, fin surface type and FPI are even MORE critical. Once this type of evaporator is built, the pressure drop through this coil can not be adjusted, unlike the variants with a nozzle where changes can be generated to achieve the desired overall pressure drop.

Ideally the tube circuiting in an evaporator coil are designed to be identical to each other for consistent pressure drop and “flash” temperature, with the first and last tube of the circuit on, or near, the warmest air side of the coil. This quickly heats the liquid refrigerant entering the coil to the flash point, and boils off any residual liquid refrigerant leaving the coil, so it does not go to the compressor. It is common for most refrigeration systems to circulate a small amount of compatible oil with the refrigerant to lubricate moving parts inside the system compressor. If the refrigerant velocity through the coil tubes is sufficiently high, the oil is pushed through and out of the coil, thus the inclusion of this lubricant is not usually a concern. However, if the “flash” temperature gets extremely low, the oil thickens and is harder to move, causing it to gather in the coil tubes. For such applications the coil circuit has to be designed for draining the oil.

Where the evaporator “flash” temperature is below 0°C , fin spacing requires careful design, owing to moisture in the air stream causing ice accumulation on the cold surfaces, blocking air flow and compromising system temperature settings, leading to coil/system failure. As with water type coils, knowing the coil hand and if the air flow is vertical or horizontal, are critical to designing the coil circuits for correct and efficient operation. In order to correctly space the fins information on the distributor nozzle and lead tube sizes, or the coil thermal performance criteria will also be required.